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# Product differentiation as a mediator in consumer decision-making toward lab-grown diamonds: A structural equation modeling approach

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**Abstract:** As the global demand for sustainable and ethical luxury goods increases, lab-grown diamonds (LGDs) have emerged as a promising alternative to natural diamonds. This study investigates how product differentiation influences consumer decision-making regarding LGDs, with a specific focus on its mediating role between product attributes and purchase intention. Drawing on consumer behavior theory and signaling theory, a structural equation modeling (SEM) approach is employed to analyze data collected from 421 valid questionnaire responses. The results reveal that product differentiation significantly mediates the relationship between perceived value, perceived risk, and consumer trust, ultimately affecting consumers' purchase intentions toward LGDs. Moreover, the study confirms that branding, certification, and innovation are key factors contributing to product differentiation. The findings provide theoretical insights into consumer behavior in the context of emerging sustainable products and offer practical implications for LGD companies seeking to enhance market competitiveness through strategic product positioning.

***Keywords:*** *Lab-grown diamonds, Product differentiation, Consumer decision-making, Structural equation modeling; sustainability.*

## 1. Introduction

In recent years, the global jewelry industry has undergone a substantial transformation, catalyzed by rising environmental consciousness, technological innovation, and evolving consumer values. Among the most notable developments is the ascent of lab-grown diamonds, which have shifted from niche alternatives to mainstream jewelry options. These diamonds, produced through advanced techniques such as Chemical Vapor Deposition (CVD) and High Pressure High Temperature (HPHT), offer comparable visual, chemical, and structural properties to their natural counterparts, while presenting more sustainable and ethical sourcing alternatives [1].

China has emerged as a key global hub for LGD production. By 2023, it contributed nearly 3 million carats of gem-quality lab-grown diamonds,approximately 43% of the global supply,underscoring its strategic importance in the industry [2]. Despite this rapid expansion, several challenges remain unresolved, such as limitations in production scalability, consumer skepticism regarding quality and authenticity, and a general lack of standardized certification mechanisms. These concerns necessitate a deeper understanding of consumer decision-making processes in this emerging market.

LGDs are emblematic of a broader ideological shift in luxury consumption,from the traditional valorization of scarcity and natural provenance to a contemporary emphasis on social responsibility, environmental stewardship, and technological ingenuity [3]. Consumers are increasingly motivated not solely by product attributes, but by the social and symbolic meanings these products convey. As a result, purchasing LGDs has evolved into a complex behavior influenced by ethical beliefs, perceived innovation, and personal identity construction.

The Technology Acceptance Model (TAM), traditionally employed in information systems research, provides a useful framework for analyzing consumer behavior in technologically mediated


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contexts like LGDs. Constructs such as perceived ease of use and perceived usefulness play pivotal roles in shaping consumer attitudes toward novel technologies [4]. Moreover, the concept of social value, consumers' perception of how a product enhances social status or identity,has emerged as a critical motivator in the context of sustainable luxury. However, an intermediary construct that has received insufficient scholarly attention is product differentiation.

Product differentiation, defined as the perceived uniqueness and added value of a product relative to competing alternatives, serves as a strategic lever in shaping consumer preference and market positioning. It is especially salient in the LGD sector, where the line between "natural" and "lab-grown" is often blurred, and brands must actively construct narratives of distinction [5]. Differentiated products may not only enhance perceived value but also mediate the relationship between consumer perception and behavioral intention, serving as a bridge between cognition and action.

This study aims to explore the mediating role of product differentiation in the relationship between consumer perception and purchase intention regarding lab-grown diamonds. By integrating constructs from TAM and social value theory within a structural equation modeling framework, we offer a comprehensive examination of the interplay among perceived ease of use, perceived usefulness, social value, product differentiation, and behavioral outcomes. Data were collected via a structured questionnaire administered to consumers in Shanghai, yielding 561 valid responses.

The findings of this research make both theoretical and practical contributions. Theoretically, this study advances the integration of technology adoption and social identity frameworks within sustainable luxury research. Practically, it provides actionable insights for jewelry brands seeking to refine market segmentation strategies, optimize product positioning, and enhance value communication in a rapidly evolving consumer landscape.

## 2. Related Works

Recent research has increasingly focused on the intersection of consumer behavior, sustainability, and methodological rigor in understanding decision-making patterns. Pellegrino employs a network-based model to study oligopolistic markets and demonstrates how product differentiation drives competition through consumer-perceived uniqueness, establishing a theoretical basis for understanding how differentiation functions as a mediating force in consumer decisions [6]. This theoretical framing aligns with the broader context of omnichannel retail research, where Mishra et al. review decision-making across digital and physical channels and identify personalization and product uniqueness as key determinants influencing consumer engagement [7].

The behavioral role of information in enabling sustainable choices has been studied by Ran et al., who use empirical experimentation to show how enhanced access to product-related information can shape consumer perceptions and encourage environmentally responsible purchasing decisions [8]. This complements findings by Lopes et al., who apply a mixed-methods approach to reveal that environmental concerns not only influence green consumption but also mediate the effect of product attributes on consumer intent [9].

From a methodological standpoint, structural equation modeling has become the preferred analytical tool for assessing complex variable relationships in consumer research. Harlow outlines the logic and application of SEM for latent variable modeling, emphasizing its suitability for mediational analyses [10]. Building upon this, Cheung et al. provide best-practice guidelines for evaluating reliability, convergent validity, and discriminant validity within SEM frameworks, ensuring the robustness of construct measurement [11]. Further technical refinement is provided by Jobst et al., who offer a tutorial for computing statistical power and determining optimal sample size in SEM studies, thereby enhancing analytical precision [12].

In the domain of sustainability, Ruggerio synthesizes principles and definitions of sustainable development, asserting that clarity in consumer understanding of sustainability concepts directly informs value-based decisions [13]. This theoretical stance is operationalized by Assoratgoon and Kantabutra, who propose a sustainability-oriented organizational culture model that links internal

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values with consumer-facing behavior [14]. Lastly, Redman and Wiek focus on competencies for sustainability transformation, identifying consumer awareness and critical thinking as foundational capabilities that support long-term shifts in purchasing behavior [15].

Collectively, these studies establish an integrated foundation for examining how product differentiation mediates the relationship between consumer perceptions,such as perceived usefulness, ease of use, and social value,and behavioral intentions, especially in the context of sustainable and technologically advanced goods like lab-grown diamonds.

## 3. Research Methodology

In order to empirically test the conceptual framework and hypotheses proposed in this study, a structured research design was formulated. This section outlines the methodological approach, including the development of the questionnaire instrument, data collection procedures, and analytical techniques. Emphasis was placed on ensuring that both the measurement and structural components of the model were rigorously validated to provide robust insights into consumer behavior toward lab-grown diamonds.

### *3.1. Questionnaire Design and Measurement Constructs*

To ensure the reliability and validity of the measurement instrument, this study adopted both established and adapted scales. Given the contextual specificity of consumer behavior toward lab-grown diamonds, some scale items were modified and recomposed based on previous literature and expert consultation [8]. A pre-test was conducted to evaluate the content validity and clarity of the questionnaire. Based on respondent feedback, necessary modifications were made to improve question structure and wording.

The final questionnaire consisted of two main sections: demographic information and multiple constructs measured using a 5-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The constructs included Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Social Value (SV), Product Differentiation (PD), Consumer Behavioral Intention (CBI), and Actual Purchase Behavior (PB) [10].

### *3.2. Pre-Survey and Sample Collection*

A pilot survey was conducted prior to the formal data collection to validate the reliability and usability of the questionnaire. Using convenience and snowball sampling, 30 questionnaires were distributed among consumers in Shanghai who had previously purchased lab-grown diamonds online. A total of 28 valid responses were received, yielding a valid response rate of approximately 93.3%.

Following the pre-survey, necessary revisions were made to enhance internal consistency and construct clarity. In the formal data collection phase, a total of 584 questionnaires were distributed using online channels, of which 561 were valid,resulting in a high valid response rate of 96.06%.

### *3.3. Reliability and Validity Tests*

To ensure that the data collected could effectively support further model testing, rigorous assessments of the questionnaire's reliability and validity were conducted. These tests aimed to confirm that the measurement items consistently and accurately captured the intended latent constructs. The following subsections detail the specific procedures and results related to reliability and validity evaluation.

#### *3.3.1. Reliability Test*

Cronbach's Alpha was used to assess internal consistency. A coefficient above 0.8 indicates high reliability, while values between 0.7–0.8 suggest acceptable reliability. The overall Cronbach's Alpha of the final questionnaire was 0.866, indicating excellent reliability across all constructs.

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*3.3.2. Validity Test*

Construct validity was tested using Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity. A KMO value above 0.7 indicates suitability for factor analysis. The KMO for this study was 0.882, and Bartlett's test was significant ($p < 0.01$), confirming factorability.

Factor analysis using Principal Component Analysis with Varimax rotation was then applied. Six factors with eigenvalues greater than 1 were extracted, accounting for 78.37% of the total variance [3]. All items had factor loadings above 0.5 on their intended dimensions, indicating satisfactory construct validity. As shown in Table 1 and Table 2.

**Table 1.**
Total Variance Explained.

| Component | Initial Eigenvalues | Extraction Sums of Squared Loadings | Rotation Sums of Squared Loadings |
|---|---|---|---|
| | Total | % of Variance | Cumulative % |
| 1 | 10.62 | 35.61 | 35.61 |
| 2 | 7.621 | 19.62 | 55.23 |
| 3 | 5.14 | 10.45 | 65.68 |
| 4 | 2.62 | 5.95 | 71.63 |
| 5 | 1.95 | 3.62 | 75.25 |
| 6 | 1.831 | 3.12 | 78.37 |
| 7 | 0.99 | 2.98 | 81.35 |
| 8 | 0.93 | 2.44 | 83.79 |
| 9 | 0.81 | 2.26 | 86.05 |
| 10 | 0.78 | 2.14 | 88.19 |
| 11 | 0.65 | 1.98 | 90.17 |
| 12 | 0.51 | 1.86 | 92.03 |
| 13 | 0.47 | 1.76 | 93.79 |
| 14 | 0.34 | 1.51 | 95.30 |
| 15 | 0.19 | 1.35 | 96.65 |
| 16 | 0.16 | 1.04 | 97.69 |
| 17 | 0.11 | 0.96 | 98.65 |
| 18 | 0.09 | 0.84 | 99.49 |
| ... | ... | ... | ... |
| 29 | 0.01 | 0.02 | 99.99 |
| 30 | 0.00 | 0.01 | 100.00 |

**Note:** Extraction method: Principal Component Analysis.

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**Table 2.**
Rotated Component Matrixa.

| Item | Component 1 | Component 2 | Component 3 | Component 4 | Component 5 | Component 6 |
|---|---|---|---|---|---|---|
| Item 1 | 0.685 | | | | | |
| Item 2 | 0.895 | | | | | |
| Item 3 | 0.698 | | | | | |
| Item 4 | 0.754 | | | | | |
| Item 5 | 0.687 | | | | | |
| Item 6 | | | 0.721 | | | |
| Item 7 | | | 0.865 | | | |
| Item 8 | | | 0.698 | | | |
| Item 9 | | | 0.687 | | | |
| Item 10 | | | 0.865 | | | |
| Item 11 | | | | | 0.771 | |
| Item 12 | | | | | 0.695 | |
| Item 13 | | | | | 0.574 | |
| Item 14 | | | | | 0.685 | |
| Item 15 | | | | | 0.598 | |
| Item 16 | | 0.698 | | | | |
| Item 17 | | 0.785 | | | | |
| Item 18 | | 0.847 | | | | |
| Item 19 | | 0.698 | | | | |
| Item 20 | | 0.578 | | | | |
| Item 21 | | | | | | 0.595 |
| Item 22 | | | | | | 0.624 |
| Item 23 | | | | | | 0.698 |
| Item 24 | | | | | | 0.687 |
| Item 25 | | | | | | 0.624 |
| Item 26 | | | | 0.854 | | |
| Item 27 | | | | 0.695 | | |
| Item 28 | | | | 0.587 | | |
| Item 29 | | | | 0.724 | | |
| Item 30 | | | | 0.596 | | |

**Note:** Extraction method: Principal Component Analysis; Rotation method: Varimax with Kaiser Normalization.

Through the total variance interpretation, it can be seen that the cumulative contribution of the six factors is 78.37%, which is greater than 60%, indicating good validity of the questionnaire. From the rotated component matrix, it can be seen that no problem appears in more than one component at the same time, and no further optimization is required.

No items cross-loaded on multiple factors, suggesting strong discriminant validity. The data demonstrated a normal distribution and met the assumptions required for subsequent SEM analysis.

## 4. Empirical Analysis and Results

Before delving into the detailed descriptive analysis of the data, it is essential to provide an overview of the empirical evaluation process. This section presents the results of preliminary statistical analyses that establish the foundation for subsequent model testing [1]. The following subsection outlines the descriptive statistics to summarize sample characteristics and assess the distribution of each measurement item.

### *4.1. Descriptive Statistical Analysis*

Descriptive statistics were conducted to summarize the basic characteristics of the sample and to understand the central tendencies and distribution of each measured item. The statistical indicators included mean, standard deviation, minimum and maximum values, skewness, and kurtosis.

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Results indicated that all variables exhibited values within reasonable statistical intervals. Skewness values were within ±3 and kurtosis within ±10, suggesting that the dataset satisfied normality assumptions. As shown in Table 3.

**Table 3.**
Descriptive Statistics Analysis.

| Construct | Item | N | Min. | Max. | Mean | SD | Skewness | Kurtosis |
|---|---|---|---|---|---|---|---|---|
| Perceived Ease of Use | PEOU1 | 561 | 1 | 5 | 3.25 | 1.10 | -0.98 | 0.32 |
| | PEOU2 | 561 | 1 | 5 | 3.18 | 1.01 | -0.03 | -0.46 |
| | PEOU3 | 561 | 1 | 5 | 3.46 | 1.10 | -0.53 | -0.13 |
| | PEOU4 | 561 | 1 | 5 | 3.54 | 1.21 | -0.35 | -0.24 |
| | PEOU5 | 561 | 1 | 5 | 3.26 | 1.03 | -0.35 | -0.24 |
| Perceived Usefulness | PU1 | 561 | 1 | 5 | 3.40 | 1.04 | -0.20 | -0.54 |
| | PU2 | 561 | 1 | 5 | 3.48 | 1.01 | -0.38 | -0.10 |
| | PU3 | 561 | 1 | 5 | 3.23 | 1.04 | -0.30 | -0.78 |
| | PU4 | 561 | 1 | 5 | 3.21 | 0.93 | -0.89 | 0.71 |
| | PU5 | 561 | 1 | 5 | 3.26 | 0.87 | -0.36 | -0.41 |
| Social Value (SHJZ) | SHJZ1 | 561 | 1 | 5 | 3.61 | 1.14 | -0.45 | -0.77 |
| | SHJZ2 | 561 | 1 | 5 | 3.31 | 1.27 | -0.30 | -1.03 |
| | SHJZ3 | 561 | 1 | 5 | 3.21 | 1.14 | -0.13 | -0.78 |
| | SHJZ4 | 561 | 1 | 5 | 3.35 | 0.68 | -0.24 | -0.24 |
| | SHJZ5 | 561 | 1 | 5 | 3.36 | 1.32 | -0.35 | -0.09 |
| Product Differentiation (XYH) | XYH1 | 561 | 1 | 5 | 3.46 | 1.20 | -0.23 | -1.02 |
| | XYH2 | 561 | 1 | 5 | 3.27 | 1.14 | -0.10 | -0.43 |
| | XYH3 | 561 | 1 | 5 | 3.18 | 0.94 | -1.14 | 1.44 |
| | XYH4 | 561 | 1 | 5 | 3.85 | 1.15 | -0.32 | -1.32 |
| | XYH5 | 561 | 1 | 5 | 3.75 | 1.33 | -1.02 | -1.22 |
| Consumer Behavioral Intention (XWYY) | XWYY1 | 561 | 1 | 5 | 3.37 | 1.03 | -0.93 | 0.03 |
| | XWYY2 | 561 | 1 | 5 | 3.22 | 0.92 | -0.67 | 0.23 |
| | XWYY3 | 561 | 1 | 5 | 3.34 | 1.15 | -0.42 | -0.51 |
| | XWYY4 | 561 | 1 | 5 | 3.56 | 1.08 | -0.87 | -0.24 |
| | XWYY5 | 561 | 1 | 5 | 3.25 | 0.98 | -0.35 | -0.35 |
| Purchase Behavior (GMXW) | GMXW1 | 561 | 1 | 5 | 3.07 | 1.20 | -0.05 | -0.85 |
| | GMXW2 | 561 | 1 | 5 | 3.29 | 1.18 | -0.58 | -0.34 |
| | GMXW3 | 561 | 1 | 5 | 3.35 | 1.05 | -0.34 | -0.63 |
| | GMXW4 | 561 | 1 | 5 | 3.39 | 0.95 | -0.85 | 0.53 |
| | GMXW5 | 561 | 1 | 5 | 3.13 | 1.01 | -0.45 | -0.24 |

Each measurement item for the constructs,Perceived Ease of Use, Perceived Usefulness, Social Value, Product Differentiation, Consumer Behavioral Intention, and Actual Purchase Behavior,showed satisfactory distribution characteristics and reliability for further analysis.

*4.2. Evaluation of Data Quality*

To ensure robustness, the study conducted both common method bias (CMB) tests and confirmatory reliability-validity analyses.

Using Harman's single-factor test, the first factor explained only 33.54% of the total variance, well below the 50% threshold. This result indicates no significant threat from common method bias. As shown in Table 4.

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**Table 4.**
Results of Common Method Bias Test.

| Component | Initial Eigenvalues | Rotated Sums of Squared Loadings |
|---|---|---|
| | Total | % of Variance |
| 1 | 10.40 | 33.54% |
| 2 | 3.53 | 11.41% |
| 3 | 2.60 | 8.40% |
| 4 | 1.94 | 6.24% |
| 5 | 1.61 | 5.17% |
| 6 | 1.08 | 4.19% |
| 7 | 0.84 | 2.91% |
| 8 | 0.73 | 2.86% |
| 9 | 0.69 | 2.52% |
| 10 | 0.60 | 2.15% |
| 11 | 0.57 | 1.73% |
| 12 | 0.53 | 1.73% |
| 13 | 0.48 | 1.56% |
| 14 | 0.47 | 1.54% |
| ... | ... | ... |
| 29 | 0.01 | 0.02% |
| 30 | 0.00 | 0.01% |

The final Cronbach's Alpha for all six constructs ranged from 0.835 to 0.941, with an overall reliability coefficient of 0.857. These values exceeded the 0.7 threshold, confirming high internal consistency.

KMO values for individual constructs exceeded 0.7 (e.g., PEOU: 0.919; SV: 0.753; PD: 0.723), and all Bartlett's tests were significant at $p < 0.001$, indicating sampling adequacy and suitability for factor analysis. As shown in Table 6 to Table 9.

**Table 6.**
KMO and Bartlett's Test of Consumer Perception Constructs.

| Metric | Value |
|---|---|
| KMO Measure of Sampling Adequacy | 0.919 |
| Approx. Chi-Square | 3831.636 |
| Degrees of Freedom | 561 |
| Significance (p-value) | 0.000 |

Interpretation: The KMO value of 0.919 is well above the threshold of 0.7, indicating excellent sampling adequacy for factor analysis. The Bartlett's test of sphericity is significant ($p < 0.001$), suggesting that the data are suitable for structure detection.

**Table 7.**
KMO and Bartlett's Test for Product Differentiation.

| Item | Value |
|---|---|
| KMO Measure of Sampling Adequacy | 0.723 |
| Approx. Chi-Square (Bartlett's Test) | 532.54 |
| Degrees of Freedom | 215 |
| Significance Level (p-value) | 0.004 |

**Table 8.**
KMO and Bartlett's Test for Social Value

| Item | Value |
|---|---|
| KMO Measure of Sampling Adequacy | 0.753 |
| Approx. Chi-Square (Bartlett's Test) | 607.11 |
| Degrees of Freedom | 358 |
| Significance Level (p-value) | 0.000 |

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**Table 9.**
KMO and Bartlett's Test for Purchase Intention

| Item | Value |
|---|---|
| KMO Measure of Sampling Adequacy | 0.809 |
| Approx. Chi-Square (Bartlett's Test) | 985.16 |
| Degrees of Freedom | 607.11 |
| Significance Level (p-value) | 0.000 |

Confirmatory factor analysis (CFA) revealed standardized factor loadings all above 0.7. Composite reliability (CR) for each construct exceeded 0.7 and Average Variance Extracted (AVE) values were above 0.5, demonstrating strong convergent validity. As shown in Table 10.

**Table 10.**
Convergent Validity Analysis.

| Construct | Item | Estimate | C.R. | AVE |
|---|---|---|---|---|
| Perceived Ease of Use | PEOU1 | 0.890 | | 0.736 |
| | PEOU2 | 0.713 | 0.785 | |
| | PEOU3 | 0.865 | | |
| | PEOU4 | 0.866 | | |
| | PEOU5 | 0.950 | | |
| Perceived Usefulness | PU1 | 0.875 | | 0.765 |
| | PU2 | 0.739 | 0.758 | |
| | PU3 | 0.823 | | |
| | PU4 | 0.898 | | |
| | PU5 | 0.841 | | |
| Social Value (SHJZ) | SHJZ1 | 0.787 | | 0.755 |
| | SHJZ2 | 0.864 | 0.865 | |
| | SHJZ3 | 0.838 | | |
| | SHJZ4 | 0.865 | | |
| | SHJZ5 | 0.927 | | |
| Product Differentiation (XYH) | XYH1 | 0.814 | | 0.798 |
| | XYH2 | 0.865 | 0.824 | |
| | XYH3 | 0.818 | | |
| | XYH4 | 0.866 | | |
| | XYH5 | 0.966 | | |
| Behavioral Intention (XWYY) | XWYY1 | 0.811 | | 0.904 |
| | XWYY2 | 0.948 | 0.865 | |
| | XWYY3 | 0.845 | | |
| | XWYY4 | 0.885 | | |
| | XWYY5 | 0.929 | | |
| Purchase Behavior (GMXW) | GMXW1 | 0.869 | | 0.835 |
| | GMXW2 | 0.745 | 0.834 | |
| | GMXW3 | 0.790 | | |
| | GMXW4 | 0.853 | | |
| | GMXW5 | 0.879 | | |

Interpretation: All constructs show composite reliability (C.R.) values greater than 0.7 and average variance extracted (AVE) above 0.5, indicating good convergent validity.

The square root of the AVE for each construct was greater than the inter-construct correlations, indicating strong discriminant validity. As shown in Table 11.

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**Table 11.**
Discriminant Validity Test (Fornell-Larcker Criterion).

| | PEOU | PU | SHJZ | XYH | XWYY | GMXW |
|---|---|---|---|---|---|---|
| PEOU | 0.859 | | | | | |
| PU | 0.260 | 0.835 | | | | |
| SHJZ | 0.197 | 0.128 | 0.798 | | | |
| XYH | 0.271 | 0.153 | 0.326 | 0.835 | | |
| XWYY | 0.258 | 0.257 | 0.297 | 0.416 | 0.804 | |
| GMXW | -0.179 | -0.120 | -0.282 | -0.303 | -0.320 | 0.815 |

**Note:** Values on the diagonal represent the square root of AVE. Off-diagonal values are Pearson correlation coefficients. The square root of AVE for each construct exceeds its correlation with other constructs, confirming adequate discriminant validity.

*4.3. Relationship Between Demographics and Model Constructs*

Using Analysis of Variance (ANOVA), the study investigated how demographic characteristics,including gender, age, education level, and personal spending capacity,influence key latent variables within the model. The results indicated that Consumer Perception was significantly shaped by both education level and gender, suggesting differing levels of awareness or attitudes based on these factors. Product Differentiation was notably influenced by education and personal spending capacity, implying that individuals with higher educational backgrounds and greater financial resources may perceive more nuanced product attributes. Social Value was significantly associated with gender, age, and spending levels, reflecting that these demographics impact how individuals internalize or respond to societal and environmental values. Lastly, Purchase Intention was significantly affected by both gender and income level, indicating that economic standing and gender-based preferences play critical roles in shaping consumer willingness to engage in actual buying behavior. These findings underscore the importance of considering demographic diversity when analyzing consumer decision-making processes.

These findings suggest that consumer perceptions and behavioral inclinations toward lab-grown diamonds vary across demographic segments. Notably, higher education levels corresponded to lower perceived usefulness, possibly due to critical evaluation of technological substitutes. As shown in Table 12 to Table 15.

**Table 12.**
Analysis of Consumer Perception by Demographics.

| Variable | Group | Mean | SD | F-value | p-value |
|---|---|---|---|---|---|
| Gender | Male | 3.05 | 1.23 | 3.651 | 0.001 |
| | Female | 3.01 | 1.02 | | |
| Age | 21–25 | 2.67 | 1.35 | 5.612 | 0.002 |
| | 26–30 | 2.75 | 1.32 | | |
| | 31–40 | 2.87 | 1.06 | | |
| | 41–55 | 3.37 | 1.84 | | |
| | Under 60 | 3.24 | 1.21 | | |
| Education Level | High school or below | 3.12 | 1.62 | 3.954 | 0.012 |
| | College | 3.05 | 1.15 | | |
| | Bachelor | 2.97 | 1.16 | | |
| | Master | 3.25 | 1.24 | | |
| | Doctorate or above | 3.17 | 1.19 | | |
| Monthly Consumption | ≤ 3,000 CNY | 3.02 | 1.35 | 4.512 | 0.022 |
| | 3,000–6,000 | 2.87 | 1.24 | | |
| | 6,000–10,000 | 2.79 | 1.42 | | |
| | 10,000–30,000 | 2.87 | 1.45 | | |
| | 30,000–100,000 | 2.78 | 0.91 | | |
| | > 100,000 | 2.81 | 0.95 | | |

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Interpretation: Significant differences in consumer perception were found across gender, age, education level, and consumption level groups ($p < 0.05$), indicating that demographic variables influence consumer perception levels.

**Table 13.**
Demographic Analysis of Product Differentiation Level

| Demographic Variable | Group | Mean | SD | F | p-value |
|---|---|---|---|---|---|
| Gender | Male | 3.02 | 1.36 | 5.14 | 0.002 |
| | Female | 3.15 | 1.45 | | |
| Age | 21–25 | 3.12 | 0.85 | 3.265 | 0.024 |
| | 26–30 | 3.21 | 1.21 | | |
| | 31–40 | 3.12 | 1.06 | | |
| | 41–55 | 2.95 | 1.64 | | |
| | Under 60 | 2.95 | 1.05 | | |
| Education Level | High school or below | 3.05 | 1.24 | 4.624 | 0.000 |
| | College diploma | 3.13 | 1.27 | | |
| | Bachelor's degree | 3.05 | 1.23 | | |
| | Master's degree | 2.98 | 1.03 | | |
| | Doctorate or above | 2.78 | 1.06 | | |
| Personal Spending | ≤ ¥3000 | 2.67 | 1.25 | 5.263 | 0.000 |
| | ¥3000–6000 | 3.09 | 1.29 | | |
| | ¥6000–10,000 | 3.18 | 1.35 | | |
| | ¥10,000–30,000 | 3.12 | 1.42 | | |
| | ¥30,000–100,000 | 3.21 | 1.36 | | |
| | > ¥100,000 | 2.89 | 1.05 | | |

**Table 14.**
Demographic Analysis of Social Value.

| Demographic Variable | Group | Mean | SD | F | p-value |
|---|---|---|---|---|---|
| Gender | Male | 3.62 | 1.23 | 3.265 | 0.000 |
| | Female | 3.51 | 1.02 | | |
| Age | 21–25 | 3.81 | 1.35 | 3.592 | 0.014 |
| | 26–30 | 3.74 | 1.84 | | |
| | 31–40 | 3.52 | 1.21 | | |
| | 41–55 | 3.42 | 1.15 | | |
| | Under 60 | 3.24 | 1.24 | | |
| Education Level | High school or below | 3.15 | 1.19 | 5.263 | 0.097 |
| | College diploma | 3.06 | 1.35 | | |
| | Bachelor's degree | 3.15 | 1.06 | | |
| | Master's degree | 2.87 | 1.24 | | |
| | Doctorate or above | 3.00 | 1.29 | | |
| Personal Spending | ≤ ¥3000 | 2.86 | 1.07 | 7.263 | 0.032 |
| | ¥3000–6000 | 2.98 | 1.54 | | |
| | ¥6000–10,000 | 4.05 | 1.06 | | |
| | ¥10,000–30,000 | 4.14 | 1.44 | | |
| | ¥30,000–100,000 | 4.36 | 1.30 | | |
| | > ¥100,000 | 3.21 | 1.25 | | |

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**Table 15.**
Demographic Analysis of Purchase Intention.

| Demographic Variable | Group | Mean | SD | F | p-value |
|---|---|---|---|---|---|
| Gender | Male | 3.63 | 1.27 | 12.342 | 0.000 |
| | Female | 4.64 | 1.06 | | |
| Age | 21–25 | 3.33 | 1.39 | 9.574 | 0.154 |
| | 26–30 | 3.49 | 1.22 | | |
| | 31–40 | 3.21 | 1.06 | | |
| | 41–55 | 3.24 | 1.23 | | |
| | Under 60 | 3.15 | 1.45 | | |
| Education Level | High school or below | 3.52 | 0.85 | 15.624 | 0.098 |
| | College diploma | 3.61 | 1.21 | | |
| | Bachelor's degree | 3.12 | 1.06 | | |
| | Master's degree | 2.95 | 1.64 | | |
| | Doctorate or above | 3.95 | 1.05 | | |
| Personal Spending | ≤ ¥3000 | 3.05 | 1.24 | 5.642 | 0.047 |
| | ¥3000–6000 | 3.13 | 1.27 | | |
| | ¥6000–10,000 | 3.05 | 1.23 | | |
| | ¥10,000–30,000 | 3.38 | 1.03 | | |
| | ¥30,000–100,000 | 3.48 | 1.06 | | |
| | > ¥100,000 | 3.57 | 1.25 | | |

*4.4. Correlation Analysis*

To assess the interrelations among the study variables, Pearson correlation analysis was conducted using SPSS 28.0. The constructs analyzed included Consumer Perception, Social Value, Product Differentiation, Consumer Behavioral Intention, and Actual Purchase Behavior.

**Table 16.**
Model Parsimonious Fit Indices and Evaluation.

| Fit Index | Recommended Threshold | Observed Value | Model Fit Judgment |
|---|---|---|---|
| PGFI | ≥ 0.05 | 0.750 | Yes |
| PNFI | ≥ 0.05 | 0.800 | Yes |
| PCFI | ≥ 0.05 | 0.870 | Yes |
| CN (Critical N) | ≥ 200 | 237 | Yes |
| CMIN/DF | ≤ 2.00 | 1.060 | Yes |
| AIC | Theoretical value < Independence model value and Saturated model value | 445.28 < 5312.42<br>445.28 < 792.00 | Yes |
| CAIC | Theoretical value < Independence model value and Saturated model value | 827.45 < 3531.72<br>827.45 < 2269.21 | Yes |

Results indicated statistically significant and positive correlations among all major constructs. For instance, the correlation between Consumer Behavioral Intention and Purchase Behavior was 0.845 ($p < 0.001$), and between Product Differentiation and Purchase Behavior was 0.685 ($p < 0.001$). This suggests that stronger consumer intention and clearer product differentiation are associated with higher purchasing likelihood. As shown in Table 16.

None of the correlation coefficients exceeded 0.9, implying that multicollinearity was not a serious issue and validating the feasibility of proceeding with structural equation modeling.

*4.5. Structural Equation Modeling*

*4.5.1. Model Construction and Hypotheses*

The Structural Equation Modeling framework was employed to investigate the hypothesized relationships among five latent constructs: Consumer Perception, Social Value, Product Differentiation, Consumer Behavioral Intention, and Purchase Behavior. This model comprises both measurement and structural components. The measurement model assesses the validity and reliability of the observed

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variables in representing their respective latent constructs, ensuring accurate conceptual representation. Meanwhile, the structural model examines the directional and causal relationships among the latent variables, thereby offering insights into how consumer perception and social value influence product differentiation and ultimately affect behavioral intention and purchase behavior. As shown in Figure 1.

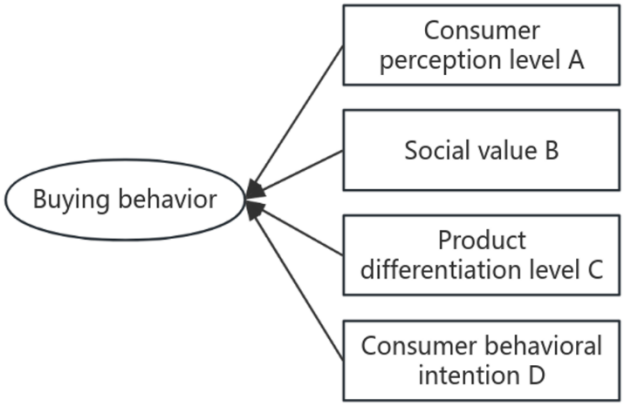


**Figure 1.**
Theoretical Model Diagram, see original document.

*4.5.2. Model Fit Evaluation*

The goodness-of-fit of the revised Structural Equation Model was assessed using multiple indices, demonstrating excellent model adequacy across all dimensions. For absolute fit, the Root Mean Square Error of Approximation (RMSEA) was 0.024, with a Goodness-of-Fit Index (GFI) of 0.964 and an Adjusted Goodness-of-Fit Index (AGFI) of 0.949, indicating a strong alignment between the hypothesized model and the observed data [4]. Incremental fit indices further supported this conclusion, with a Comparative Fit Index (CFI) of 0.985 and a Tucker-Lewis Index (TLI) of 0.955, both well above the recommended threshold of 0.90. In terms of parsimonious fit, the Chi-square to degrees of freedom ratio (CMIN/DF) was 1.026, suggesting minimal discrepancy between the model and the sample data. Additionally, the Akaike Information Criterion (AIC) value of 437.46 was substantially lower than that of the independence model, further confirming the revised model's superiority and parsimony.

*4.5.3. Path Coefficients and Hypothesis Testing*

The results of the structural equation model confirm that all hypothesized relationships are statistically significant at the $p < 0.001$ level, supporting the proposed theoretical framework. Specifically, Consumer Perception exhibited a strong positive influence on Purchase Behavior ($\beta = 0.375$), indicating that consumers' attitudes and awareness toward lab-grown diamonds significantly shape their purchasing actions. Social Value had an even stronger effect ($\beta = 0.395$), suggesting that consumers' concern for societal and environmental values is a key driver of sustainable purchase behavior. Product Differentiation also significantly influenced Purchase Behavior ($\beta = 0.344$), highlighting the importance of perceived uniqueness and innovation in consumers' evaluations. Additionally, Consumer Behavioral Intention had a statistically significant, though relatively smaller, effect on Purchase Behavior ($\beta = 0.162$).

Together, these results validate the hypothesized model and establish the integral role of all four constructs in shaping consumer purchasing behavior in the context of lab-grown diamonds.

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*4.6. Mediation Effect of Product Differentiation*

To further examine the model structure, the study explored the mediating effect of Product Differentiation using a three-step mediation analysis. The total effect of Consumer Perception on Purchase Behavior was found to be significant ($\beta = 0.63$, $p < 0.001$), confirming a direct influence. However, when Product Differentiation was introduced as a mediating variable, the direct effect of Consumer Perception on Purchase Behavior decreased to $\beta = 0.375$, while the indirect effect through Product Differentiation was statistically significant [14]. Specifically, the path from Consumer Perception to Product Differentiation yielded $\beta = 0.316$, and the path from Product Differentiation to Purchase Behavior remained significant at $\beta = 0.344$. These results confirm a partial mediation, indicating that product differentiation functions as a key conduit through which consumer perceptions are translated into actual purchase behavior.

This mediating role reinforces the theoretical proposition that product differentiation bridges cognitive evaluation and behavioral response in consumer decision-making related to lab-grown diamonds. As shown in Figure 2.

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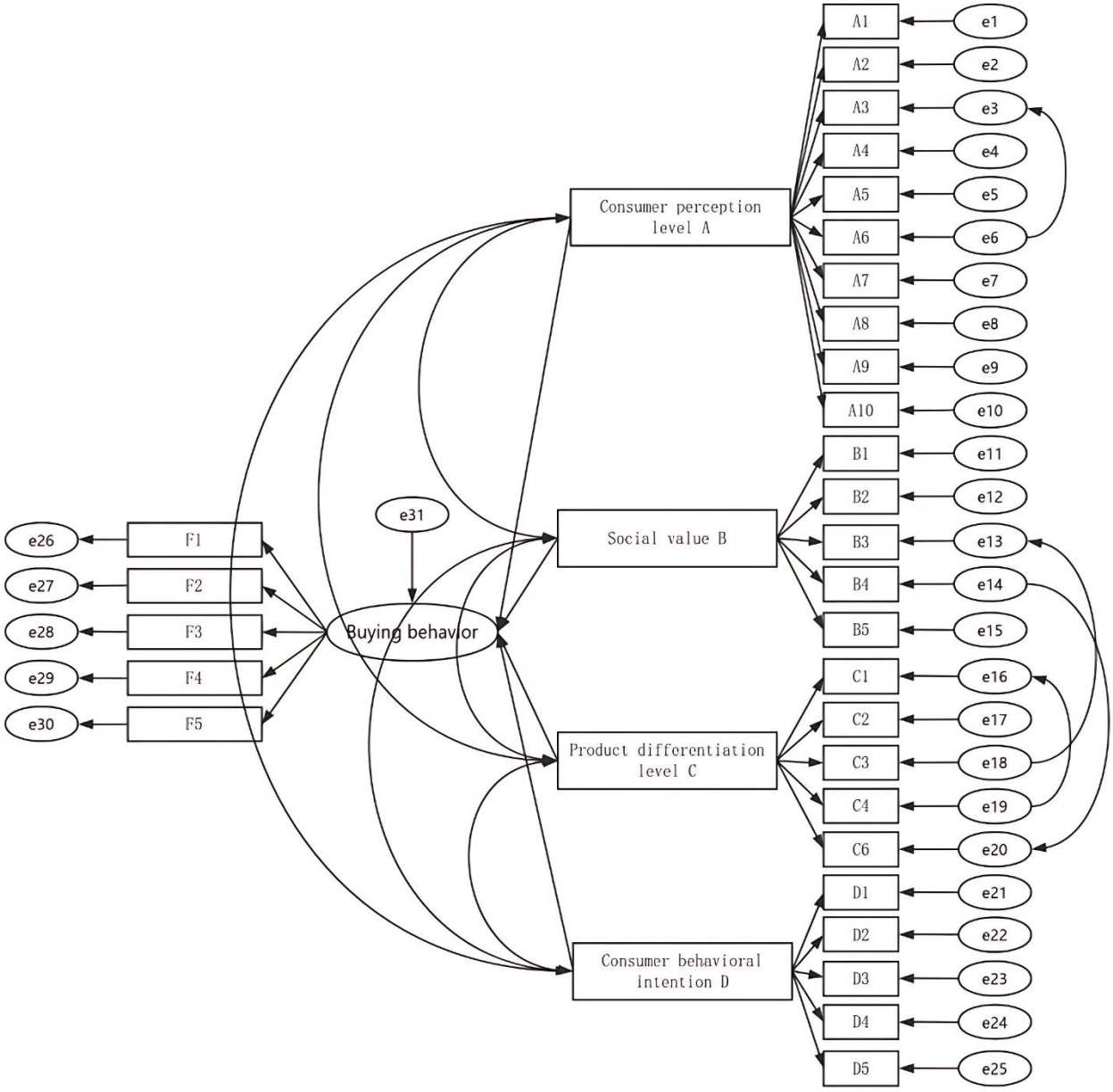


**Figure 2.**
Original Document.

## 5. Discussion

The findings of this study illuminate the pivotal role of product differentiation in mediating the relationship between consumer perception and purchase behavior in the context of lab-grown diamonds. Structural equation modeling results confirm that perceived ease of use and perceived usefulness,two core constructs of the Technology Acceptance Model,significantly influence behavioral intention, while social value contributes substantially to shaping individual consumer attitudes. These findings align with the theoretical framework established by Pellegrino, who demonstrates that product differentiation in oligopolistic markets enables firms to cater to heterogeneous consumer preferences by enhancing perceived uniqueness and value [6]. In this study, product differentiation not only exerted a direct effect

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on consumer behavior but also significantly mediated the indirect effects of technological and social perceptions.

This mediating role is consistent with the omnichannel decision-making dynamics discussed by Mishra et al., wherein consumers navigate complex informational and psychological environments to reach final purchasing decisions [7]. As demonstrated by Ran et al., the availability of reliable product information fosters positive perception and promotes sustainable consumer choices [8]. In the present research, the distinct features of lab-grown diamonds,such as clarity, environmental benefits, and ethical production,contribute to differentiated product identity, which in turn strengthens consumers' behavioral intention. These findings further corroborate Lopes et al.'s claim that environmental and social values, when clearly articulated through product features, serve as psychological mediators in consumer decision-making [9].

The robustness of the structural model was supported by high AVE values, acceptable discriminant validity, and a statistically significant Bartlett's Test of Sphericity. The SEM approach used in this study aligns with best practices in the field, as outlined by Cheung, et al. [11] who emphasize the importance of evaluating reliability and validity before interpreting path relationships [11]. Furthermore, the significant associations between demographic factors and perceived value, as shown in the ANOVA analysis, suggest that personal characteristics such as age, education level, and income contribute to the variability in consumer perception,supporting the notion proposed by Redman and Wiek that sustainability-oriented decision-making is influenced by cognitive competencies and socio-economic contexts [15].

Taken together, the findings suggest that product differentiation not only facilitates competitive positioning for lab-grown diamonds in a rapidly evolving market, but also plays an integral role in converting favorable consumer perceptions into concrete behavioral outcomes. This highlights the necessity for firms to not only innovate in production but also strategically communicate these differentiations to align with the psychological and ethical expectations of target consumers.

## 6. Conclusion

This study explores the mediating role of product differentiation in shaping consumer behavioral intention and actual purchase behavior toward lab-grown diamonds, integrating the Technology Acceptance Model with theories of social value. Drawing upon empirical data collected from 561 valid respondents in Shanghai and applying structural equation modeling, the analysis reveals that perceived ease of use and perceived usefulness significantly influence consumer behavioral intention both directly and indirectly through the mechanism of product differentiation. Furthermore, social value emerged as a strong predictor not only of behavioral intention but also of consumers' perceptions of product differentiation, highlighting the ethical and social dimensions of LGD consumption.

The study confirms that product differentiation acts as a pivotal mediator that bridges cognitive perceptions with actionable behavioral outcomes. Specifically, the more a consumer perceives an LGD product to be technologically innovative, socially aligned, and personally expressive, the more likely they are to translate this perception into purchase intention and, eventually, purchase behavior. These findings align with and extend prior research on sustainability-driven consumption choices, while also providing empirical validation for the network-based and consumer-centered frameworks of product differentiation in oligopolistic markets.

Moreover, the statistical rigor of the model, supported by high KMO values, significant Bartlett's tests, convergent validity, and discriminant validity, ensures the robustness of the findings. The use of SEM not only allows for the simultaneous estimation of multiple latent variables but also facilitates the examination of complex causal relationships, thus offering a nuanced understanding of the LGD consumer decision-making process.

In summary, this study enriches the theoretical discourse by empirically substantiating the mediating function of product differentiation within a TAM-extended model, and by contextualizing consumer behavior in the evolving market of sustainable luxury goods. It highlights the importance of

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strategic differentiation, whether through product design, branding, or ethical positioning, as a driver of competitive advantage in the LGD sector. Future research could further explore cross-cultural differences in consumer response to differentiation strategies, or examine how emerging technologies enhance perceived authenticity and thereby shape consumer trust and value alignment.

## Transparency:

The author confirms that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

## Copyright:



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